Appendix E
Stained Glass Conditions Report

Femenella and Associates, Inc.

FIRST UNITARIAN SOCIETY OF PLAINFIELD
PLAINFIELD, NEW JERSEY

STAINED GLASS WINDOW SURVEY

DATE OF REPORT

The data for this report was gathered Tuesday, October 16, 2007. This report was completed on February 24, 2008.

INTRODUCTION

Femenella & Associates, Inc. (F&A) was asked by Historic Building Architects, LLC, to inspect the windows of the Sanctuary. The inspection will assist the architect with the identification of existing damage, to define the underlying causes of the damage and to assist with the development of a sound, cost-effective plan for the restoration and long-term maintenance of the windows.

PROCEDURE

Arthur Femenella and Helen Ryan visited the site. The stained and leaded glass windows were viewed from the ground, on both the interior and exterior sides of the building. Mr. Femenella photographed the windows in digital format. These findings have been incorporated into this report.

THE STAINED & LEADED GLASS WINDOWS

There are two basic design styles found in the windows of the Society.

Leaded Glass Windows. Most of the windows in the Sanctuary are leaded glass windows. The distinction between leaded glass and stained glass is that stained glass has one or more pieces of glass that have been painted or stained with a vitreous paint and fired after the glass has been manufactured. Leaded glass, while the glass may have color, has no additionally applied painted or stained surfaces (See Photo 1 – Part IV).

The leaded glass of the Society comprises rolled and textured glass held in a lead came matrix. This matrix is further supported by round saddle bars and copper tie wires. Rolled (or cast) glass is a translucent glass with 50-80% light transmission, depending on its thickness and type of surface. It is used where transparency of the glass sheet is not important or not desired. To produce rolled glass, molten glass pours from the melting tank over a refractory barrier (the "weir") and onto the machine slab where it flows under a refractory gate (the "tweel"), which regulates the volume of glass, and then between two water-cooled rollers. The distance between the rollers determines the thickness of the glass. Often, one or more of the rollers has a texture on its surface that imparts a texture to the finished glass.

Painted and Stained Windows. This group includes two windows made from full antique glass and extensively painted with trace and matte vitreous paint (See Photo 2 – Part IV). Antique glass is more accurately described as mouth blown glass. To fabricate the glass, a large blob of molten glass is held on the end of a long hollow metal tube. The worker then blows air into the blob to form a small bubble. The glass is repeatedly re-heated and more air blown in until the glass has formed a bubble perhaps two feet long. The worker then cuts off the ends of

the bubble leaving a cylinder. The cylinder is then cut length ways and the glass is unfolded to form a sheet. This is all done while the glass is very hot. It is a slow and highly skilled job. The sheet of glass must then be cooled in a controlled way so as not to introduce cooling stresses into the glass. The final sheet can be a few square feet in size.

The Robinson window was designed and fabricated by the Oliver Smith Studio of Bryn Athyn, Pennsylvania.

DESCRIPTION:

The windows are fabricated from a varied palette of full antique, rolled and textured glass. In the more decorative windows, there are a number of specialized treatments used to decorate the individual pieces of glass. Most of the glass has been skillfully hand-painted with trace, matte, and enamel vitreous paints. The paint is made of ground glass, metallic oxide coloring agents, and a flux to lower the melting temperature. It is applied to the interior surface of the glass via one or more media (i.e. gum Arabic and water, oil, alcohol, etc.). After drying and manipulation of the paint with stiff brushes and/or wood picks, the glass is fired in a kiln at between 1050° F and 1250° F. It is fired until, depending on the chemical nature of the particular paint, it vitrifies and becomes one with the glass substrate.

Silver stain is a mixture of silver nitrate, gum gamboge and a flux. It is applied to the exterior of the glass and fired at 1150° F to 1250° F. The stain penetrates the surface of the glass, imparting a stain to it that may range from pale amber to deep orange. The final color of the stain is dependent upon the chemistry of the stain, the chemistry of the glass, the amount of stain applied and the temperature to which it is fired.

There is use of etched, flashed glass throughout the windows. Flashed glass is a full-antique glass (mouth-blown) comprising a base layer of a pale color and, on the interior surface, a thin layer of intense color (the flash). The flash side can be masked and etched with hydrofluoric acid. This process can result in sharply defined detail lines, or an overall shading of the color in a particular area, depending on the intent of the artist.

The windows are constructed of lead cames (resembling an “H”) that contain the glass, support bars that are attached to the lead, and a framing system that secures the window to the building. The individual pieces of glass are held together with lead cames. The lead came matrix is supported by either saddle bars or flat bars.

Saddle bars are round steel or iron bars that can be set into wood frames or attached to a steel ventilator sash, and then attached to the lead came matrix with copper tie-wires. The tie-wires are soldered onto the lead joints of the glass panel. Upon installation, the wires are folded around the bars, twisted tightly, cut to a uniform length, and the ends are folded over parallel to the saddle bars. Flat bars are flat steel bars that have been galvanized, either hot-dipped or electro-plated. The bars are soldered directly onto the lead came matrix at the intersection of two or more lead cames. The ends of the flat bars are tapered and fitted into grooves in the frame upon installation.

The windows are set in one of two ways. Most of the panels are set directly into a rebate in the wood frame or sash. The panels are set from the exterior and they are retained with nails and hard setting putty. A number of these windows have operating ventilator sections. The ventilator stained glass is set into a steel operating sash that sits within the steel ventilator frame (See Photo 3 – Part IV).

All of the windows have protective glazing (PG) applied to the exterior. The glazing is primarily plastic. Some of the plastic appears to be acrylic and the balance is polycarbonate (See Photo 4 - Part IV). The PG is applied in two ways. Most of it is installed into the profile of the wood frame. It is secured with screws and caulk. The ventilator sections are single glazed. Where the ventilators have been left operable, the PG has been applied directly to the stained glass and secured with caulk. This method is often referred to as *piggybacked* (See Photo 3 – Part IV). None of the PG is properly vented during its original installation. However, due to deterioration of the sealant materials, some of the PG is now self-venting.

GENERAL CONDITIONS:

The windows of the Society range from poor to good condition. The actual condition of each window is determined by location, age, size, and manufacturing firm. The following general types of deterioration were found during this inspection of the windows. Individual window conditions will be found elsewhere herein.

DEFLECTION

Deflection is the bowing and bending of the individual leaded panels away from the original, flat design plane. Contrary to common belief, gravity and wind loading play minor roles in the deflection of stained glass windows. The primary cause is the force generated by the expansion/contraction cycle. This force is distributed throughout the window as a function of the concentration of lead cames present in an area, and the temperature differential that the window experiences. The exact portion of the window that deflects is a function of the strength of the local force exerted, and the ability of that area of the window to resist deflection. The ability of the window to resist deflection is determined by many factors, some of which are:

1. Pattern of the lead lines. Weak patterns include straight lines that form hinge joints allowing the panel to fold; concentric circles allow the focus of the circles to telescope in or out; multiple, thin borders allow the panel to fold.

2. Insufficient or poorly applied support bars.

3. The panel fitting too tightly into its frame. This inhibits the ability of the panel to expand and contract within a flat plane.

4. The use of hard setting sealant compounds. This inhibits the ability of the panel to expand within a flat plane.

5. The use of a soft alloy to fabricate the lead cames. These are more subject to bending than alloys containing .6 - .9% tin and antimony.

Many of the windows of the Society show deflection.

BROKEN GLASS

There is incidence of cracked, broken, and missing glass throughout the windows. The breaks are caused by:

1. Deflection. The window bends beyond the tensile strength of the glass. Long, thin pieces and complex concave shaped pieces tend to be the first to break.

2. Rapid deceleration. When the ventilators are slammed shut, strong forces are exerted on the panel, breaking the weaker pieces.

3. Poor Previous Repairs. There is evidence that some of the windows were worked on in-situ in the past. This resulted in broken glass in many of the windows. Windows such as these cannot be restored in place.

4. Impact.

DIRT

There is an accretion of dirt on all surfaces of the glass. This is compounded on the figural windows were dirt has infiltrated between the layers of glass. This is a combination of soot from the original furnace, and other air-borne contaminants. This layer of dirt may become hygroscopic, absorbing water and holding it close to the glass. This presents a threat to the physical stability of the glass as well as interferes with the esthetic appreciation of the windows.

QUALITY OF LEAD CAME ALLOY

There is evidence that a weak alloy of lead was used to fabricate the lead cames of most of the windows. This was typical in windows made from this period, and dates back to the late 19th century when developments in the refining process allowed for the fabrication of pure lead cames. Unfortunately, many of the "impurities" that were removed from the lead had actually made an alloy that was stronger, and more resistant to fatigue damage and deflection. This original design flaw should be addressed during any restoration project.

METAL FATIGUE

Leaded glass windows are designed to flex and move when subject to the stresses of wind loads and the effects of expansion and contraction. The constant flexing of the lead came matrix over long periods of time results in failure due to metal fatigue. The evidence of this failure can be seen upon close inspection of the lead cames. Broken solder joints and small cracks in the lead came have developed. The broken solder joints are not serious, and can be repaired. The cracks in the lead came are more serious, and evince the need for replacement of the lead cames.

Both broken solder joints and cracked leads can be seen on some of the windows of the Society. The addition of trace amounts of copper and/or silver to the lead alloy during the restoration will greatly magnify the lead cames' resistance to metal fatigue.

LEAD CORROSION

Lead corrodes when exposed to various chemicals in the environment. The typical type of corrosion is from inorganic acids in the air. This causes a dark patina to form on the surface of the lead and is self-sealing, preventing corrosion of the metal below the surface. A second and more damaging type of corrosion is caused by attack by organic acids. This results in a white powder (lead carbonate) forming on the surface of the lead cames. This type of corrosion is not self-sealing. It is difficult to gauge the actual levels of corrosion on many of the windows of the Society due to the obscuring plastic PG. However, wherever the underlying lead cames can be seen, extensive lead carbonate corrosion is present (See Photo 5 - Part IV).

FAILURE OF THE LEAD CAME MATRIX

Due to the three previously mentioned types of deterioration, the lead came matrices of many of the windows are beginning to fail.

GLASS PAINT

Glass paint does not fade. However, the paint may fail and fall off the window in a pattern that resembles fading. This failure can have a number of causes, including improper glass firing, incompatibility between the paint and glass substrate, and the use of an improper flux. Regardless of the original cause, all paint failure is exacerbated by the constant presence of moisture. The majority of the paint on the windows appears sound.

WATERPROOFING COMPOUND

There is evidence that the waterproofing compound that seals the colored glass within the lead cames, has broken down. This is a result of the loss of the binding oil (most likely linseed oil) from the calcium carbonate based waterproofing compound. As the oil dries, the putty turns to powder and falls out from under the flanges of the lead cames. In the plated window, the calcium carbonate becomes trapped between the layers of glass.

STEEL CORROSION

Many of the windows are set into a groove between the exterior stone and the interior terra cotta. The individual panels are supported by steel Tee bars. The exact detail of the steel Tee bars is not clear, but it appears to be a single Tee bar that supports both the stained glass and the PG. While there are horizontal and vertical steel Tees, the Tees does not appear to be welded to a perimeter steel angle frame. All of the steel evinces advanced stages of corrosion, resulting in rust heaving and distortion of the metal profiles. The ventilator sections are steel as well. The lack of a perimeter frame makes the system difficult to properly waterproof due to the extensive movement at the intersection of the steel and the stone.

POOR PREVIOUS REPAIRS

Other problems with the windows are the result of well intentioned but misguided previous attempts at repair. Some of the broken glass has resulted from attempts to flatten bulged windows in place. There are a number of poor previous replacement pieces. The improperly installed PG has damaged the windows.

WOOD FRAME DETERIORATION

The wood sash and frames of the windows of the of the Society exhibit varying stages of deterioration. The build-up of earlier coatings is quite unstable. The early organic coatings have dried, become brittle and shrunk, causing them to lift off the wood substrate. The sill of Window 101 is dropping away from the vertical mullions. This is probably due to a structural failure in the sub sill of this window. This is a serious concern and must be addressed during any restoration or repair effort.

Invariably, the sill, the lower three feet of the jambs and mullions, the intersections of wood joinery at the corners of the sashes and frames are the areas where the deterioration is most advanced. Water has infiltrated into the wood frames. As the temperature climbs, the wood and the trapped water are heated. Some of the water in the wood is transformed into water vapor. The water vapor follows the laws of gases, not liquids. As the vapor is heated, it expands, exerting pressure within the wood. The laws of physics dictate that all gasses under pressure move toward equilibrium. To achieve equilibrium, the vapor must leave the wood. As it does so, it forces the paint film to fail and peel from the frame.

SPECIFIC CONDITIONS FOUND.

The following is a brief discussion of the specific conditions found in the individual windows. The work needed is prioritized as follows:

Priority A - As Soon As Possible, but no longer than 3 years;
Priority B – 3 to 8 years;
Priority C – 15 years or as funds allow;
Priority D – no work in the near future.

The Priority Levels discussed above have been determined based primarily on the physical condition of the windows, rather than their artistic importance. Clearly, the Robinson window is the most important, and this fact should be considered when determining exactly when each window is restored and how the Society's resources are implemented.

WINDOW 101 "The Robinson Window" Priority: A

Dimensions: OA: 176" w x 222" h; Glass Size: 176" w x 208" h

Provenance: Oliver Smith Studio, Bryn Athyn, PA (signed).

Inscription: "Glory to God in the Highest, Peace on Earth, Goodwill toward Men."

Description:

The window is fabricated from a rich and varied palette of full antique glass. Much of this palette may have been made at the glass works that used to be at Bryn Athyn Cathedral. The glass is skillfully painted with vitreous trace and matte paint. The overall design scheme is an interesting interpretation of the medieval medallion style windows. Very well done.

There are six lancets and fourteen pieces of tracery set into a wood surround. Two (2) center pivot ventilators, one in Lancet I, and one in Lancet VI. The stained glass panels are set from the exterior into a rebate in the wood frame and retained with hard setting putty. The individual panels are supported on steel T-bars that are set correctly with the web facing to the exterior.

Entire window is covered on the exterior with unvented, plastic protective glazing ("PG"). The glazing is set directly into a rebate in the exterior wood profile. The individual panels are supported with aluminum tee bars with snap on moldings. These T-bars have been affixed to the wood frame, probably with screws.

Condition:

Entire window is suffering the effects of water damage. There may be some improperly annealed glass. There is moderate to severe deflection throughout the window. There are many cracks; some have been covered (but not fixed) with "Dutchman repairs." (However, this may have occurred during the initial installation. If the glass was improperly cooled during its creation, it is subject to unwarranted cracking.) The wooden frame moves with moderate pressure. The wood sill has dropped and is separating from the vertical mullions. There is extensive lead corrosion on both the interior and exterior of the window, which is unusual for a 60-year old window. This is most likely due to the excessive moisture present. There is paint loss on the inscription, again most likely due to excessive moisture in the immediate microenvironment (wall, sill, protective glazing).

Panels(s): All lancet panels show signs of deflection, ranging from moderate to severe. Tracery deflection seems less severe. The support system is comprised of T-bars (primary) and round bars with copper tie wires (secondary). Many of the round bars are too short and do not engage the edges of the frame (See Lancet VI), hence offering no support whatsoever. Lancet IV, Panel B shows excessive deflection. Lancet V, Panel D shows at least seven cracked pieces.

Some repairs have been attempted, including minor releading; replacement of missing glass with clear glass and bad "cold paint" (Lancet V); the aforementioned "Dutchman"; Lancet

III, Panel D has poor repairs and resoldering. Lancet II, Panel D (the bottom panel) and Lancet V, Panel D have poor replacement glass. In addition, the texture of the paint is questionable.

Ventilator(s): Two steel center-pivot ventilators (Lancet I & Lancet VI). Neither opens due to the protective glazing on the exterior.

P.G.: Unvented plastic, caulked, shows signs of bowing.

Work Plan:

Entire window needs to be removed and releaded; paint to be stabilized. New protective glazing system designed. Protective screens should be considered in place of the exterior glazing. The wood frame needs to be stabilized and requires serious attention, possibly including two vertical supports to stiffen the frame.

Panel(s): Entire window needs to be removed and releaded. Broken pieces need to be edge-glued, and/or repaired with copper foil. At least three (3) pieces need to be repainted. Possible use of cover plates. Perform annealing test on some of the glass.

Ventilator(s): Society may want to consider making ventilators fixed, if protective glazing is to be reinstalled.

P.G.: Existing protective glazing should be removed and discarded. System must be redesigned for proper air exchange or substituted with a protective screen system.

Window 101

WINDOW 106 — Priority: A - C

Dimensions: OA 24” w x 58” h; Glass Size – 16” w x 50” h.

Description: Rolled glass in a lead came matrix with wood frame. Supported by round bars and tie wires.

Condition:
Panel(s): Moderate lead corrosion. Minor metal fatigue. Minor deflection.

Work Plan:
Panel(s): **A Priority**: Remove protective glazing and discard. Waterproof panel in-situ.

C Priority: Remove and relead.

WINDOW 107 **Priority: A - C**

Dimensions: OA 60" w x 58" h; Glass Size Lancet – 16" w x 50" h, Vent size 14 ½" w x 27"h.

Description: Three lancets with wood frame; steel center-pivot ventilator. Rolled and textured glass held in a lead came matrix. Supported by round bars and tie wires. PG is piggybacked onto existing single glazed ventilator.

Condition:

Panel(s): Moderate lead corrosion. Minor metal fatigue. Minor deflection.

Ventilator(s): Moderate to severe lead corrosion. Moderate to severe metal fatigue. Minor deflection.

Work Plan:

Panel(s): **A Priority**: Remove protective glazing and discard. In-situ waterproof upper center panel and panels of the left and right lancets.

C Priority: Remove balance of center lancet and both side lancets; relead.

Ventilator(s): **A Priority**: Remove ventilator sash and frame. Relead ventilator panel. Sandblast and powder coat ventilator. Make operable.

WINDOW 108 **Priority: B**

Dimensions: Three lancet window, each lancet 15" w x 48" h.

Provenance: Oliver Smith Studios, Philadelphia, PA.

Description:

Window is supported by round bars with copper tie wires. Most of the glass is unpainted. 50% of it is full antique. The window is fabricated from a palette of full antique, rolled and opalescent glass. The Earth and Moon are portrayed in opalescent glass. Some of the glass is hand-painted with vitreous trace and matte paint. While this window was made by Smith, it is not nearly as interesting as Window 101.

Window has three lancets set into a wood surround. There are no ventilators The glass is held in a lead came matrix and further supported by round saddle bars that are attached to the panels with copper tie wires. The stained glass panels are set from the exterior into a rebate in the wood frame and retained with hard setting putty.

Entire window is covered on the exterior with unvented, plastic protective glazing ("PG"). The glazing is set directly into a rebate in the exterior wood profile.

Condition:

There is moderate to severe deflection throughout the window. There are five pieces of broken glass. There is extensive lead corrosion on both the interior and exterior of the window, which is unusual for a window of this age. This is most likely due to the excessive moisture present. The paint appears to be stable.

Work Plan: **B Priority**: Remove and relead. Remove and discard protective glazing. Consider using protective screens if the Society wants to continue to protect this window.

WINDOW 109 **Priority: A - C**

Dimensions: OA 60" w x 58" h; Glass Size– 16" w x 50" h, Vent size 14 ½" w x 27"h.

Description: Three lancets with wood sash and frame; steel center-pivot ventilator. Rolled and textured glass held in a lead came matrix. Supported by round bars and tie wires. PG is piggybacked onto existing single glazed ventilator.

Condition:

Panel(s): Some broken glass. Moderate lead corrosion. Minor metal fatigue. Minor deflection.

Ventilator(s): Moderate to severe lead corrosion and metal fatigue. Minor deflection. Piggyback protective glazing. One good replacement on Lancet II.

Work Plan:

Panel(s): **A Priority**: Remove protective glazing and discard. Remove Center Lancet, waterproof and reinstall. In-situ waterproof panels of the left and right lancets.

C Priority: Remove balance of center lancet and both side lancets; relead.

Ventilator(s): **A Priority**: Remove ventilator sash and frame. Relead ventilator panel. Sandblast and powder coat ventilator. Make operable.

WINDOW 151 **Priority: A**

Dimensions: OA 60" w x 58" h; Glass Size 16" w x 50" h, Vent size 14 ½" w x 27"h.

Description: Three lancets with wood sash and frame; steel center-pivot ventilator. Rolled and textured glass held in a lead came matrix. Supported by round bars and tie wires. PG is piggybacked onto existing single glazed ventilator.

Condition:

Panel(s): Moderate to severe lead corrosion. Minor metal fatigue. Minor deflection.

Ventilator(s): Moderate to severe lead corrosion. Moderate to severe metal fatigue. Minor deflection. Does not operate.

Work Plan:

Panel(s): **A Priority**: Remove protective glazing and discard. Remove balance of center lancet and both side lancets; relead

Ventilator(s): **A Priority**: Remove ventilator sash and frame. Relead ventilator panel. Sandblast and powder coat ventilator. Make operable.

WINDOW 152 — Priority: A

Dimensions: OA 60" w x 58" h; Glass Size – 16" w x 50" h, Vent size 14 ½" w x 27"h.

Description: Three lancets with wood sash and frame; steel center-pivot ventilator. Rolled and textured glass held in a lead came matrix. Supported by round bars and tie wires. PG is piggybacked onto existing single glazed ventilator.

Condition:

Panel(s): Moderate to severe lead corrosion. Minor metal fatigue. Minor deflection.

Ventilator(s): Moderate to severe lead corrosion. Moderate to severe metal fatigue. Minor deflection. Does not operate.

Work Plan:

Panel(s): **A Priority**: Remove protective glazing and discard. Remove balance of center lancet and both side lancets; relead

Ventilator(s): **A Priority**: Remove ventilator sash and frame. Relead ventilator panel. Sandblast and powder coat ventilator. Make operable.

WINDOW 153 **Priority: A**

Dimensions: OA 60” w x 58” h; Glass Size– 16” w x 50” h, Vent size 14 ½” w x 27”h.

Description: Three lancets with wood sash and frame; steel center-pivot ventilator. Rolled and textured glass held in a lead came matrix. Supported by round bars and tie wires. PG is piggybacked onto existing single glazed ventilator.

Condition:

Panel(s): Moderate to severe lead corrosion. Minor metal fatigue. Minor deflection.

Ventilator(s): Moderate to severe lead corrosion. Moderate to severe metal fatigue. Minor deflection. Does not operate.

Work Plan:

Panel(s): **A Priority**: Remove protective glazing and discard. Remove balance of center lancet and both side lancets; relead.

Ventilator(s): **A Priority**: Remove ventilator sash and frame. Relead ventilator panel. Sandblast and powder coat ventilator. Make operable.

WINDOW 154 **Priority: A**

Dimensions: OA - 37” w x 58” h; Glass Size 14” w x 50” h.

Description: Two lancets with wood sash and frame; steel center-pivot ventilator. Rolled and textured glass held in a lead came matrix. Supported by round bars and tie wires.

Condition:
Panel(s): Six broken pieces. Moderate to severe lead corrosion. Minor metal fatigue. Minor deflection.

Work Plan:
Panel(s): **A Priority**: Remove protective glazing and discard. Remove lancets; relead.

WINDOW 201 **Priority: A - C**

Dimensions: OA 44" w x 76" h; Glass size 16" w x 62"h. Vent 14 ½" w x 25" h

Description: Two lancets with wood sash and frame; steel center-pivot ventilator. Rolled and textured glass held in a lead came matrix. Supported by round bars and tie wires. PG is piggybacked onto existing single glazed ventilator.

Condition:

Panel(s): No broken glass. Minor lead corrosion. Minor metal fatigue. Minor deflection.

Ventilator(s): One bad replacement piece. Moderate to severe lead corrosion. Moderate to severe metal fatigue. Minor deflection.

Work Plan:

Panel(s): **A Priority**: Remove protective glazing and discard. In-situ waterproof upper panel above ventilator and complete other lancet.

C Priority: Remove both lancets; relead.

Ventilator(s): **A Priority**: Remove ventilator sash and frame. Relead ventilator panel. Sandblast and powder coat ventilator. Make operable.

WINDOW 202 **Priority: A**

Dimensions: OA 44" w x 76" h; Glass size 16" w x 62"h. [Vent same as 153]

Description: Two lancets with wood sash and frame; steel center-pivot ventilator. Rolled and textured glass held in a lead came matrix. Supported by round bars and tie wires. PG is piggybacked onto existing single glazed ventilator.

Condition:

Panel(s): No broken glass. Minor lead corrosion. Minor metal fatigue. Minor deflection.

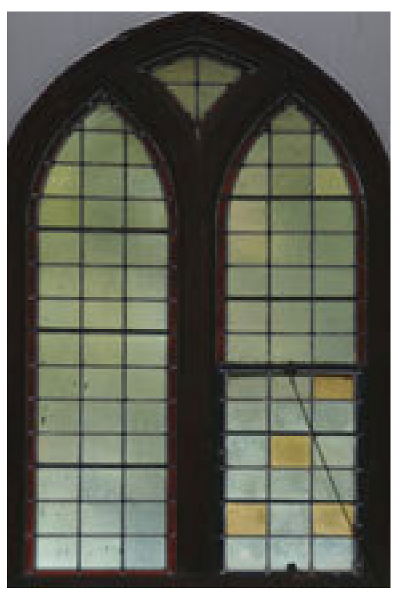
Ventilator(s): Four (4) bad replacements in ventilator. Moderate to severe lead corrosion. Moderate to severe metal fatigue. Minor deflection.

Work Plan:

Panel(s): **A Priority**: Remove protective glazing and discard. In-situ waterproof upper panel above ventilator and complete other lancet.

C Priority: Remove lancets; relead.

Ventilator(s): **A Priority**: Remove ventilator sash and frame. Relead ventilator panel. Sandblast and powder coat ventilator. Make operable.



WINDOW 203 **Priority: A**

Dimensions: OA 44” w x 76” h; Glass size 16” w x 62”h.

Description: Two lancets with wood sash and frame; steel center-pivot ventilator. Rolled and textured glass held in a lead came matrix. Supported by round bars and tie wires. PG is piggybacked onto existing single glazed ventilator.

Condition:

Panel(s): No broken glass. Minor lead corrosion. Minor metal fatigue. Minor deflection.

Ventilator(s): No poor replacements. Moderate to severe lead corrosion. Moderate to severe metal fatigue. Minor deflection.

Work Plan:

Panel(s): **A Priority**: Remove protective glazing and discard. In-situ waterproof upper panel above ventilator and complete other lancet.

C Priority: Remove lancets; relead.

Ventilator(s): **A Priority**: Remove ventilator sash and frame. Relead ventilator panel. Sandblast and powder coat ventilator. Make operable.

WINDOW 211 **Priority: A-C**

Dimensions: OA 44" w x 76" h; Glass size 16" w x 62"h.

Description: Two lancets with wood sash and frame; steel center-pivot ventilator. Rolled and textured glass held in a lead came matrix. Supported by round bars and tie wires. PG is piggybacked onto existing single glazed ventilator.

Condition:

Panel(s): Three (3) bad breaks in the tracery, two (2) bad breaks in the lower right corner of the right lancet. One (1) bad replacement in the right lancet. Minor lead corrosion. Minor metal fatigue. Minor deflection.

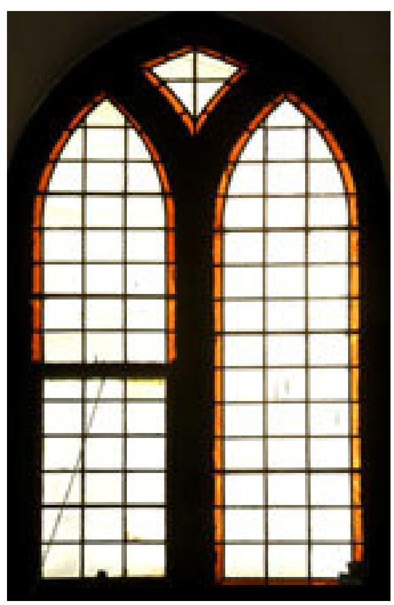
Ventilator(s): One bad replacement piece. Moderate to severe lead corrosion. Moderate to severe metal fatigue. Minor deflection.

Work Plan:

Panel(s): **A Priority**: Repair broken glass in lower right corner. Remove lancet and relead. Remove protective glazing and discard. In-situ waterproof upper panel above ventilator and complete other lancet.

C Priority: lancets; relead.

Ventilator(s): **A Priority**: Remove ventilator sash and frame. Relead ventilator panel. Sandblast and powder coat ventilator. Make operable.



WINDOW 212 **Priority: A-C**

Dimensions: OA 44" w x 76" h; Glass size 16" w x 62"h.

Description: Two lancets with wood sash and frame; steel center-pivot ventilator. Rolled and textured glass held in a lead came matrix. Supported by round bars and tie wires. PG is piggybacked onto existing single glazed ventilator.

Condition:

Panel(s): No broken glass. Minor lead corrosion. Minor metal fatigue. Minor deflection.

Ventilator(s): Two (2) bad replacements in ventilator. Moderate to severe lead corrosion. Moderate to severe metal fatigue. Minor deflection.

Work Plan:

Panel(s): **A Priority**: Remove protective glazing and discard. In-situ waterproof upper panel above ventilator and complete other lancet.

C Priority: Remove lancets; relead.

Ventilator(s): **A Priority**: Remove ventilator sash and frame. Relead ventilator panel. Sandblast and powder coat ventilator. Make operable.

WINDOW 213 **Priority: A-C**

Dimensions: OA 44” w x 76” h; Glass size 16” w x 62”h. [Vent same as 153]

Description: Two lancets with wood sash and frame; steel center-pivot ventilator. Rolled and textured glass held in a lead came matrix. Supported by round bars and tie wires. PG is piggybacked onto existing single glazed ventilator.

Condition:

Panel(s): No broken glass. Minor lead corrosion. Minor metal fatigue. Minor deflection.

Ventilator(s): One bad replacement piece. Duct tape on perimeter of ventilator panel. Moderate to severe lead corrosion. Moderate to severe metal fatigue. Minor deflection.

Work Plan:

Panel(s): **A Priority**: Remove protective glazing and discard. In-situ waterproof upper panel above ventilator and complete other lancet.

C Priority: Remove balance of center lancet and both side lancets; relead.

Ventilator(s): **A Priority**: Remove ventilator sash and frame. Relead ventilator panel. Sandblast and powder coat ventilator. Make operable.

This completes the brief window survey.

Sincerely,

Arthur J. Femenella
President

RESTORATION PLAN

It is important that the restoration plan address the preservation of the stained glass windows in a logical and complete way. With the exception of temporary remediation of the health and safety issues, short-term fixes will not be cost-effective for the windows of the Church. Methods and materials should be employed that will obviate the need for major intervention for the next 80 to 100 years. All procedures must be documented and reversible.

RESTORATION PRIORITIES

The first priority is to address Window 101. This is the most important window in Sanctuary and it is suffering from severe structural issues. The stained glass must be entirely removed, brought to the studio and fully restored, including complete releading.

The second priority should focus on the balance of the windows. The issue of whether the Society wants to keep protective glazing (PG) must be addressed. The windows do not need to be separated from the exterior environment. The only reason to cover the windows is to protect them from impact damage. This can be better accomplished with protective screens.

INTENT

The intent of this program is to return the windows of the Church to a condition that is as close as possible to their condition when originally installed.

RECOMMENDED PROCEDURES

The following procedures are recommended to restore the stained and leaded glass, the wood and metal frames, and to design new protective glazing if desired. In our opinion, there is little need for protective glazing once the windows are properly restored. The only reason to install it would be due to the threat of vandalism at the lower levels of windows. If this is desired by the Church, I would suggest the use of stainless steel screens instead of glass or plastic. Stainless steel screens provide all of the protection that the stained glass will need to protect it from projectile damage, without setting up the damaging microenvironment that existed heretofore and caused much of the damage to these windows. These screens are currently being installed at the Cathedral of the Immaculate Conception in Camden, New Jersey.

DOCUMENTATION

All of the original conditions found and all conservation procedures employed while working on the panels should be documented. This should be accomplished with text and photographs. The original condition report should be augmented as the window undergoes conservation. This amended report should become part of the documentation package. In the final report, all procedures performed should be discussed and explained. The documentation should include photography and rubbings of all of the panels. This information should be turned over to the Church at the end of the project. This information is invaluable to the Church in the unfortunate event of a catastrophe that seriously damages the stained glass windows.

Rubbings on acid free vellum should be produced of all the windows or panels that will be completely or partially dismantled. On panels with plating, separate rubbings should be made for each layer of glass. The following should be recorded on the rubbings: (a) All lead lines; (b) Overall sizes of the panels; (c) Widths of the leads and whether flat or round; (d) Broken,

missing, or cracked pieces of glass; (e) Support bar and or tie wire attachment points; (f) Plating. Additional rubbings on Kraft paper should be made for the temporary storage and reglazing of the windows.

REMOVAL

Scaffolding or man lifts will be set up on the interior and the exterior of each window to be removed. The windows are set into steel frames or wood sash. Methods will be used to minimize any additional damage to the panels during removal. All loose fragments should be cataloged, and unstable pieces should be stabilized, to assure that no historic glass is lost or moved from its original setting. All tape stabilization should be accomplished with 3M #471 adhesive tape. This tape has a solvent resistant backing that allows for the tape to be removed without damaging the glass. No tape should be adhered to painted surfaces. All tape should be removed in the studio with cotton swabs dipped in acetone. Where necessary, crates should be fabricated so that the glass may be safely transported to the studio.

DISMANTLING

The panels should be carefully taken apart and placed onto their respective locations on the rubbings. It is impossible to affect the level of restoration needed by these panels without dismantling many of them.

FLATTEN PANELS

Sections that do not have to be releaded should be flattened. The panels should be flattened as follows: (a) The remaining putty should be removed from beneath the leads with hardwood picks, so as not to scratch the historic glass; (b) Pieces of glass at risk of breaking (such as long thin pieces) should be removed from the leads; (c) The panel should be eased back into plane with the judicious use of dry heat and gentle pressure; (d) All broken solder joints should be cleaned and resoldered with 60/40 lead tin solder, with stearic acid employed as a flux.

CLEANING

All dirt should be removed from the obverse and reverse sides of the panels. This will increase the transmission of light and add sparkling highlights to the panels. This cleaning should be done with a mild solution of Triton X (a non-ionic detergent) and water. Utmost care should be used around all painted areas.

BROKEN GLASS

The treatment of the broken glass is critical to the success of this project. There are many cracked or broken pieces of glass now in the panels. If these are simply discarded and replaced with “the best match I could find,” the artistic integrity of the window will be severely compromised. This can be seen now throughout the windows as a result of the poor replacements of the past. Replacement should be restricted to the last resort and only if an exact match is possible. All broken glass should be repaired. Wherever possible this should be done by edge-gluing or copper-foil repairs. If pieces must be repainted, the process should be annotated on the rubbings. Glass should match the shape, color, and texture of the glass to be replaced. All surface decoration (paint, silver-stain or acid-etching) must be faithfully reproduced. The Owner must approve replacement of any and all glass. Plating, the layering of one or more pieces of glass, is an acceptable way to achieve a glass match.

One of the following procedures should be used for all broken glass.

COPPER-FOIL TECHNIQUE. This technique should be used in areas where a high degree of strength is necessary; the impact of the added line is negligible; and the need for reversibility is high.

SILICONE EDGE-GLUING. This technique should be used where the need for strength is moderate; a flexible joint is desirable (due to continued stress); and the minimal adverse visual effect of the joint is negligible. This type of glue is not affected by temperature, humidity, or ultra-violet radiation.

EPOXY EDGE-GLUING. This technique should be used where the need for strength is high; the need for a near invisible joint is high; and where the repair can be protected from ultra-violet radiation. This is most appropriate for gluing painted pieces of glass; infusing cracks in the glass and infusing shattered glass.

MISSING GLASS. Based on our initial investigation, most of the original glass is still in the panels, with the exception of replacement work done in the past. However, if glass is missing, it should be dealt with as follows: Missing glass should be replaced, as closely as possible, to match the original in color, texture, and value. All missing, painted detail should be replicated.

RELEADING

Areas to be releaded should be done with an alloy lead came that contains .6-.9% antimony; .6-.9% tin; and trace amounts (.03-.06%) of copper and/or silver. The balance of the alloy is lead. This alloy will add resistance to deflection and metal fatigue. This one change alone will add twenty to thirty years of serviceable life to the restored panels. The width of the lead flange and the thickness of the heart of the lead cames should match the existing. Where flat lead is used, the end of the leads should be tucked into the lead it is joining. All lead lines should be cross-woven, and long, continuous, straight lines should be avoided.

WATERPROOFING

After complete releading, waterproofing putty should be forced under the leads. The putty should be composed of whiting (calcium carbonate) and an organic oil medium. Absolutely no Portland cement, plaster of Paris or other hardening agents should be in the mixture. The purpose of putty is to remain flexible and waterproof the panel. Hard-setting putties dramatically shorten the serviceable life of restored panels. After the putty is forced under the leads, it is cut back flush with the edge of the lead with a sharpened hardwood stick. All excess oil is cleaned away with sawdust and/or whiting and rags. The final process is a very brisk brushing with a medium stiffness brush to burnish the solder joints. Under no circumstances should patinas or coloring agents be used to darken the leads or the solder. These chemicals will lie dormant in the putty and be reactivated every time the panel is exposed to moisture.

SUPPORT SYSTEM

It is important to maintain the original support systems, from an historic and aesthetic standpoint, in addition to structural considerations. Each of the two systems presently employed

(i.e., flat bars and round bars with tie-wires) work equally well, if installed properly. The key is to engage the frame regardless of which method is chosen.

The round bars should be re-installed into the wood or metal frames and attached to the panels by means of copper tie wires. The tie wires should be firmly soldered onto the panels, bent around the round bars, twisted, cut, and folded over. Additional wires should be added wherever two leads intersect with a bar line. If flat bars are used, they should be fashioned so that they firmly engage the frame upon installation. The flat bars should be soldered directly to the lead came matrix. On the areas discussed in the window survey, additional support bars must be added to the panels to prevent the recurrence of the bowing in the future. All changes to bar locations must be approved by the Architect. The possibility of adding brass structural fins to the exterior side of the window at critical joints should be considered. The actual method used to strengthen any particular circumstance should be determined after considering numerous aesthetic and structural questions. These additions, in concert with the added round bars, will prevent the bowing problem in the future, while having a minimal effect on the design.

VENTILATORS

Wherever necessary, the operating ventilators must be adjusted and lubricated to work freely. Forced opening and closing of poorly fitted ventilators can severely damage the stained glass.

REINSTALLATION

The stained glass panels should be set into a flexible, polyurethane caulk system employing appropriate ethafoam backer rods or bond breaking tape. The panels must be correctly sized to fit into the opening. This means that the actual window opening size should be 1/8" to 3/16" larger than the full size of the stained glass window, in height as well as width. The perimeter lead can be trimmed to accommodate this resizing, but the original glass should not be cut. These allowances will permit the window to expand and contract without bowing and bulging.

FINAL DOCUMENTATION

The individual window survey should be updated after restoration is complete. The Rubbings should be tagged to identify the panel and window to which they relate. Color slides and black and white prints should be made of all of the panels, after reinstallation. All slides, negatives and prints should be processed in a way consistent with archival storage. All photos and slides should be placed into appropriate archival sleeves and marked as to panel number and window number. The amended condition reports and the rubbings should be given to the Owner for storage.

WOOD FRAME RESTORATION

All paint, caulk, filler and inappropriate patches will be stripped from the frames. Remove as much of the paint as possible with mechanical scrapers that are custom ground to match the existing wood profile. The balance of the paint can be removed with chemical strippers. After stripping, all surfaces must be washed down with mineral spirits or alcohol to remove any wax or residue left by the chemical stripper.

Remove all old caulk and any backer material from the joint between the frames and the stone surround of the building. Remove damaged sections of wood. Where the wood is too

damaged to consolidate, Dutchman repairs will be made using wood of same species milled to same profile and scarfed into the existing with waterproof glues. Extremely deteriorated wood will be consolidated and filled with epoxy compounds formulated for this work. Areas to be checked closely for deterioration are the sills, the lower three feet of the jambs and mullions, and areas in the wood tracery where water may collect easily. The key to proper consolidation of the wood fibers is not to encase the wood in epoxy, but to infuse to saturation. The wood is properly consolidated when a dull sheen is left on the wood surface. Gouges and holes in the wood, or partially missing profiles, can be rebuilt with epoxy putty. Apply the epoxy putty before the epoxy consolidant has fully cured. This will result in a better bond between the consolidant and the putty. All epoxy work will be done only when the ambient temperature is above 40°F for the application and curing phases.

Sand the wood surface smooth. Clean away all dust with tack clothes, solvent wash or compressed air. All surfaces not treated with epoxy, will be treated with a combined "natural" consolidant composed of equal parts boiled linseed oil, gum turpentine, and spar varnish. Apply two coats. Allow twenty-four hours before application of primer coat. Consolidated wood will be primed with an oil base primer as specified elsewhere herein. All epoxy surfaces will be primed within seven (7) days of application to ensure proper adhesion of paint, and to prevent ultra-violet degradation of the epoxy.

Joint between window frame and masonry surround, and all joints in the frame that may allow for the infiltration of water, will be caulked with a high grade, high expansion, polyurethane caulk compound. Frames and caulk joint will be painted with two topcoats of semi-gloss acrylic paint.

PROTECTIVE GLAZING

Once the windows of the Church are properly restored and reinstalled into the Church, there should be no need for protective glazing. However, if the Church requires the additional security of protective glazing, protective screens can be made. These will be fabricated from welded stainless steel cloth that is firmly attached to stainless steel framework and attached to the building to cover the windows in need. The screens can be painted to blend in with the architecture.

This completes the Restoration Recommendations.

Sincerely,

Arthur J. Femenella, President
Femenella & Associates, Inc.

Photo 1 – Leaded Glass

Photo 2 – Stained Glass

Photo 3 – Ventilator

Photo 4 – PG

Photo 5 – Lead Corrosion

OLIVER SMITH

Oliver Smith was born in Lynn, Massachusetts on October 1, 1896, and died on May 17, 1980 in Green Valley, Arizona. Smith suffered polio along with an injury in childhood, which resulted in his right arm becoming paralyzed and later amputated. Smith accomplished all of his stained glass and painting with only his left arm. Minard Smith, Oliver's son, reported seeing his father hold glass with his shoulder or chest where normally one would use an arm to do the work. He worked on stained glass with his father for many years at the studio in Bryn Athyn, PA.

Oliver Smith attended the Rhode Island School of Design (RSID) for six years, graduating with a degree in painting in June 1918. He gained a degree of success as a painter, and many of his paintings are still on display in museums across the United States. He met and married Hope Fales Dimond, who was also a stained glass artisan at RSID. Her son reported that she did the more delicate designs for the glass that she and Smith made together. In 1921-22, Smith toured Europe and then studied at the London School of Arts and Crafts.

Oliver Smith's studio was in Bryn Athyn, Pennsylvania in 1929, and possibly earlier. He became closely associated with the Bryn Athyn Cathedral and completed a number of the windows there. There are also a number of his windows at Princeton Chapel, Princeton, NJ; Clothier Memorial Hall, Swarthmore, PA; and Temple B'Nai Brith, Los Angeles, CA. Smith's paintings have been exhibited at the Corcoran Gallery of Art, the National Academy of Design and the Kennedy Gallery in New York City.

Smith's windows are typically in the Arts and Crafts style, with heavy medieval overtones. Oliver Smith was a good friend of Nicola D'Ascenzo, a very famous stained glass artist from Philadelphia.

STAINED GLASS WINDOW SURVEY
GLOSSARY OF STAINED GLASS TERMS

Annealing: Final cooling process in glass manufacture that gives glass its temper.

Aniline Dyes: A color-stable dye used to tint epoxy and/or silicone.

Acid Etching: Process of etching flashed antique glass with hydrofluoric acid. Effect can be sharp details or subtle shading. Used also to polish sandblasted glass.

Antique Glass: Hand-formed, mouth-blown clear or colored glass made by old glassblowing methods.

Art Glass: Commercially designed and mass-produced windows, usually ornamental design and often employing opalescent glass.

Back Painting: Painting on the back or exterior surface of the glass.

Beveled Glass: Plate glass with edges ground on a series of abrasive wheels to form a bevel that extends beyond the covering flange of the supporting came. The edge has a prismatic effect when light passes through.

Came: Extruded, cast or folded strip of metal (lead, zinc, copper or brass), usually an H or U profile, used to hold the pieces of glass together to form a stained glass window.

Canopy: Architectural element used to frame a figure or a scene.

Cartoon: The full sized drawing that depicts a stained glass window.

Cathedral Glass: Commercial, machine-rolled translucent stained glass.

Caulk: A flexible material that is applied to the perimeter of a stained glass panel or window to seal the window to the frame. Typical materials are polyurethane and silicone. If the caulk is to meet the stained glass panel, it must be a neutral-cure type.

Chancel: The part of the church that contains the altar and sometimes the choir.

Clerestory: The upper-most portion of the church that has windows.

Conchoidal Fracture: Clamshell-like fracture that can occur at the edge of a piece of glass due to contact with another piece of glass or very hard object. Often occurs along cracks that are not stabilized or repaired.

Confetti (Fractured) Glass: Hand-rolled glass to which chips of multi-colored glass have been added during manufacture.

Copper-Foil: Thin strips of copper with an adhesive backing that are applied to the edges of glass to form a substrate onto which solder is applied. May be used to mend cracks.

Cover Plate: Piece of glass that is applied to a stained glass window with **Lead Came** or **Copper-Foil**. The purpose of a cover plate is to protect fragile paint. Missing original painted details may be applied to a cover plate to restore a lost design element of the window.

Crackle Glass: Antique Glass with a crackled surface texture that is created by applying water to the glass during the cooling process.

Crown Glass: Hand-blown glass that is spun on the end of a blowpipe to form a disk. The center of the disk is thicker than the edges.

Dalle de Verre (Slab or Faceted Glass): Pieces of glass, usually about one inch thick, often faceted, set within a concrete or **Epoxy** resin matrix. In Tiffany windows, Dalles may be broken into chunks and inserted as faceted jewels.

Deflection: The bending and bowing of a stained glass panel away from its original design plane or shape.

Diapering: A painting technique whereby the glass is decorated with a lacework of a repeating pattern.

Drapery Glass: Opalescent type of glass formed into ridges during manufacture to resemble drapery folds.

Enamels: Vitreous colors applied to glass. May be transparent or opaque, low- fire or high-fire.

Epoxy: Two-part resin/catalyst system. May be opaque or water-white. One type is used to fabricate **Dalle De Verre** panels. A conservation-grade epoxy is used to edge-glue together broken pieces of glass during restoration.

Etching or Sand Blasting: Processes that alters the surface of the glass with acid or an abrasive at high pressure; often a layer of another color glass is revealed (see **Flashed Glass**). Often used in inscriptions.

Faceted Glass: See **Dalle De Verre.** May also refer to hand-faceted glass jewels used by opalescent era glass artists. Thick pieces of cast glass are chipped along the edge to produce highlights.

Favrile Glass: Iridescent glass, patented by Tiffany in the 1880's, produced by exposing the glass to heavy metal fumes in a reducing atmosphere during manufacture.

Fillet: Thin pieces of glass forming a uniform border at the perimeter of the stained glass panel. "Breakaway fillet" is added to most stone set windows; one of its functions is for it to be broken out to facilitate a removal from a stone groove installation.

Firing: Process of heating painted glass so that the glass paint fuses to the glass. Firing temperatures may range from 1,000° to 1,350°F, depending on the chemical composition of the paint, flux and glass.

Flange: (1) The flat portions of the cames that cover the glass. (2) A flat piece of lead that may be used to cover a light leak in a panel, or to accommodate a thick piece of glass.

Flashed Glass: An **Antique Glass** comprising a thin, concentrated layer of colored glass fused to the surface of another, thicker layer of lightly colored or clear glass during manufacture. The process was developed in the 14th century. There are three types of flashed glass: a) Streaky - a multi color flash or one with dramatic variation to the flash layer; b) Variegated - a single color flash that varies in thickness and thereby in hue and intensity; and c) Commercial flash - a single color, very even thickness flash, traditionally used for signs and etched nameplates.

Flat Bars: Flat, galvanized-steel bars that are soldered directly onto the interior of a stained glass panel to provide resistance to **Deflection**.

Flattening: The return of a deflected panel to its original design plane, employing gentle heat and localized pressure in a manner that does not break the glass or damage applied surface decoration.

Foil: A petal-shaped opening in Gothic tracery. The number of foils is indicated by the French prefix (i.e., *tre*foil - three petals, *quatre*foil - four petals).

Frame: The metal or wood surround that retains and supports the stained glass window. The frame may be single-glazed or double-glazed.

Glass: A mixture of silica, alkali, and coloring agents (usually metallic oxides) heated to a high temperature so that the ingredients fuse and then cool to form an amorphous solid without regular crystalline form.

Glass or Vitreous Paint: A mixture of finely ground glass, **Metallic Oxides**, **Flux** and a liquid medium such as water, oil, alcohol, etc. It must be fired to achieve permanent adhesion to the glass.

Glue Chip Glass: A clear or tinted glass with a cracked ice appearance. Produced by lightly sandblasting a piece of glass, coating it with animal hide glue and then heating the glass in an oven. The glue cures, shrinks and rips off chips of glass, resulting in the glue-chip pattern.

Gothic: Style of architecture dating from the mid-twelfth century. Associated with pointed arches, flying buttresses and the ribbed vault. This allowed for large openings in the walls and encouraged the growth of stained glass fabrication. Reinterpreted during the Gothic revival and neo-Gothic periods.

Grisaille: (1) Blackish or brownish **Vitreous Paint** used for painting on glass. (2) Window or Panel or ornamental designs composed of monochromatic, light-colored glass, usually in a geometric design and often painted.

Hammered Glass: Machine rolled glass with a hobnail texture.

Heart: The cross bar of the "H" section of the Came.

Isothermal Glazing: System of protective glazing in which the interstitial space between the stained glass and the exterior glazing is vented to the interior to a degree sufficient to ensure that the temperature and humidity of this space will closely approximate the temperature and humidity on the interior surface of the stained glass.

Jewels or Cast Glass: Glass pressed into molds to form varying shapes while the glass is molten. Jewels are then inserted into windows for a decorative effect.

Lancet: Single or multiple openings within a frame, filled with stained glass. The lancet is usually taller than it is wide, and may comprise a multiple number of individual Panels.

Lead Came: Most common form of connecting individual pieces of glass. Usually of an "H" or "U" profile. High-heart lead (the central, connecting piece of lead is unusually high) may be used to accommodate more than one piece of glass (see **Plating** below).

Lead Line: A term used in window design to indicate the placement of the **Lead Came** in the actual **Panel**. Used also to describe the pattern of **Lead Cames** within the window.

Leaded Glass: A panel within which pieces of clear or colored glass are held together by a lead came and/or copper-foil matrix. There is no paint applied to the glass.

Leading-Up or Glazing: Assembly of the glass within the lead cames, or the assembly of a **Copper-Foil** piece.

Light: A window opening bounded by a frame. May refer to **Lancets**, **Tracery** or single windows.

Mat or Matte: Application of a translucent coat of **Vitreous Paint** to the complete surface of a piece of glass. Once dry, the Matte may be manipulated with a variety of brushes or tools. When properly fired, typically retains a dull finish.

Medallion: Circular Panel or portion of a window that acts as a focal point. Often decorated with figures or a scene.

Mending Lead or Dutchman: Thin piece of lead used to cover a crack in a piece of glass. This is not considered a restoration technique. The cracked glass continues to degrade under the Mending Lead.

Metallic Oxides: Used as colorants in the manufacture of glass, and in glass paint. Typical colors obtained are: cobalt = blue; copper, selenium or gold = orange, pink or red; lead or chromium = yellow; chromium or copper = green; manganese or nickel = violet; manganese or iron = brown or black. Actual color is a function of the complete chemistry of the glass mix and the temperature to which it is taken in manufacture.

Mold-Blown Glass: Mouth-blown glass that is blown into an open topped mold. Norman Slab glass is an example of this technique.

Muff Glass: Mouth-blown glass that is blown freely into the shape of a cylinder. The cylinder is then slit and opened flat to form a sheet in an annealing oven.

Mullion: Vertical frame member that separates **Lights** or **Lancets** of stained glass.

Muntin: Horizontal frame member that separates **Lights** or Panels of glass.

Oculus: Circular window with no stone tracery.

Opalescent Glass: Glass typical of American studios from the 1880s-1920s, variegated in color, often of a milky and/or iridescent appearance. Developed by La Farge and Tiffany in the late 19th century.

Orasel Dyes: A brand name of **Aniline Dyes.** A color stable dye used to tint epoxy and/or silicone.

Painted Glass: Clear or colored glass that has been painted with trace, matte or enamel vitreous paint, or silver stain, to achieve a desired artistic effect. The painted glass is fired in a kiln until the selected paint vitrifies and fuses to the base glass.

Panel: Unit of stained glass that is Leaded-Up into one continuous section. May be of a variety of shapes.

Patina: A film produced by chemical action. This may be the result of exposure over time, or from the application of oxidizing agents during manufacture.

Pits: Holes that occur in the **Glass, Cames** or **Frames** of the window due to corrosion.

Plate Glass: Machine made glass that is ground and polished. Usually clear in color. Today, this type of glass is made by the float process, obviating the need for polishing.

Plating: The layering of one or more pieces of glass in a stained glass window to achieve a special artistic effect. Often used by Tiffany, La Farge, and other studios of the opalescent era. Plates are mechanically connected, not laminated.

Pot Metal: Glass fabricated from one color in which the distribution of color is homogeneous.

Putty, Cement or Waterproofing: Substance comprising organic oil, whiting and a coloring agent that is forced between the pieces of **Glass** and the **Cames** to make the window weather tight.

Quarry: Square or diamond shaped piece of glass. Often used in **Grisaille** windows.

Quill Work: Removal of glass paint with a quill to form multiple lines of variegated width.

Reamy Glass: Mouth-blown glass with an undulating surface showing the bubbles, striations and ridges formed in the process of blowing.

Ripple Glass: A machine-rolled glass, the rippled texture of which is imparted by the roller.

Rose Window: Circular window with radiating petals and Tracery.

Rosette: A cast lead ornament that is applied to the point of confluence of two or more leads in a window.

Saddle Bar: Round or square metal bar used to lend support to stained glass windows. The bar is set into the frame and attached to the window with tie-wires.

Sanguine: Reddish-brown paint made from hematite, iron sulphate or sienna. Often referred to as "Jean Cousine."

Sash: The operating section of a window.

Semi-Antique Glass: Machine made glass fashioned to approximate mouth-blown glass.

Silver Stain: A stain made from silver nitrate and gum gamboge and applied to the exterior of glass. When fired it produces a variety of yellow shades. Silver stain was developed in the 14th Century and was used extensively in European glass through the early 20th Century. This is the basis of the term "Stained Glass."

Solder: A mixture of tin and lead that is sweated onto the joints of a window or the **Copper-Foil** of a **Panel** to hold the supporting matrix together. The preferred ratio for stained glass work is 60/40 tin/lead.

Stenciling: A method of applying glass paint to glass. Quite popular in the 19th century.

Stick work or Stick Lighting: Scratching the unfired paint away from the surface of the glass for artistic effect. A variety of tools may be employed.

Stipple: Removing the unfired paint away from the surface of the glass with a stiff brush, usually for shading purposes.

Stopgap: The temporary repair of a broken window, executed in-situ, to prevent infiltration of water or to stabilize the **Panel**.

Structural Fins: Thin band of metal, usually brass, which is tinned on all surfaces, bent to conform to the lead line design, and sweat soldered on edge onto the **Lead Came** to stiffen the matrix.

Structural Plates: Pieces of glass that are cut to a designed shape and applied to the window employing **Lead Came** or **Copper-Foil** to provide additional support or resistance to deflection for the window.

T-Bar: A structural metal extrusion that provides vertical support as well as resistance to wind-load in stained glass window installations. The horizontal web of the T should always face to the exterior.

Tie-Wires: Metal wire, usually copper, (the French use a lead alloy) that is soldered onto the **Lead Came** matrix. During installation, the **Tie-Wires** are folded around the **Saddle Bars**, twisted tightly, cut to a uniform length and folded over perpendicular to the **Saddle Bar**.

Trace Line: Opaque painted line used in drawing facial features, outlines and details on a stained glass window.

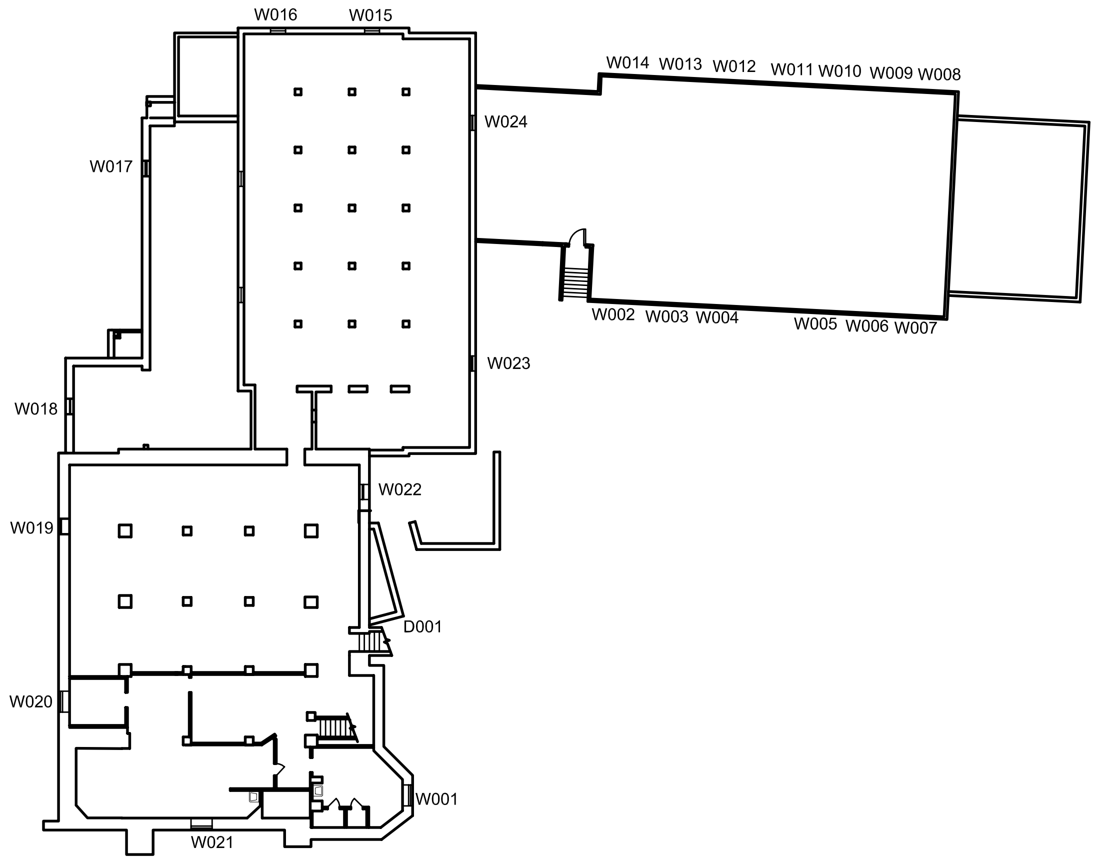
Tracery: Ornamental stonework or woodwork into which **Lights** of **Stained Glass** are set. The detail and complexity of the tracery can help to identify the country of origin and the period in which it was designed.

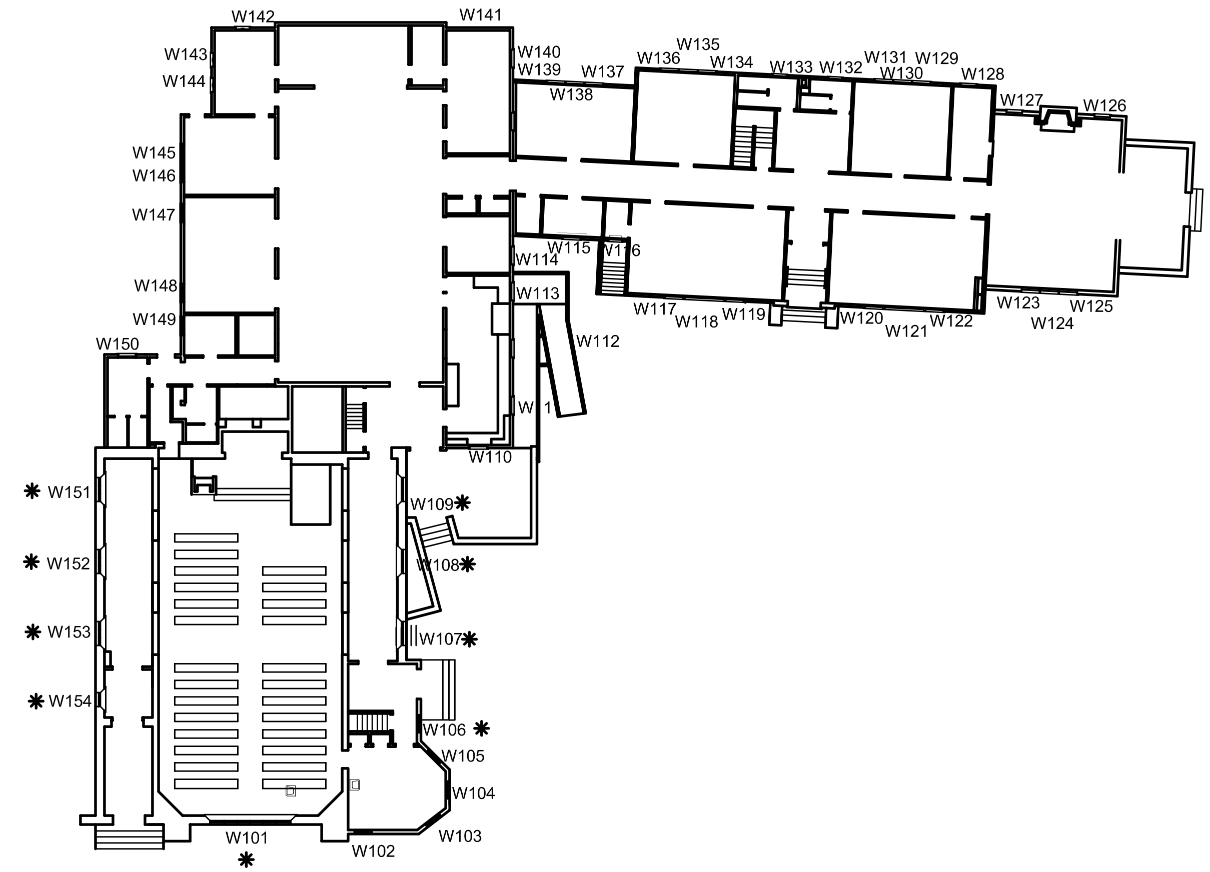
Transept: The projecting portion of the church, between the chancel and the nave.

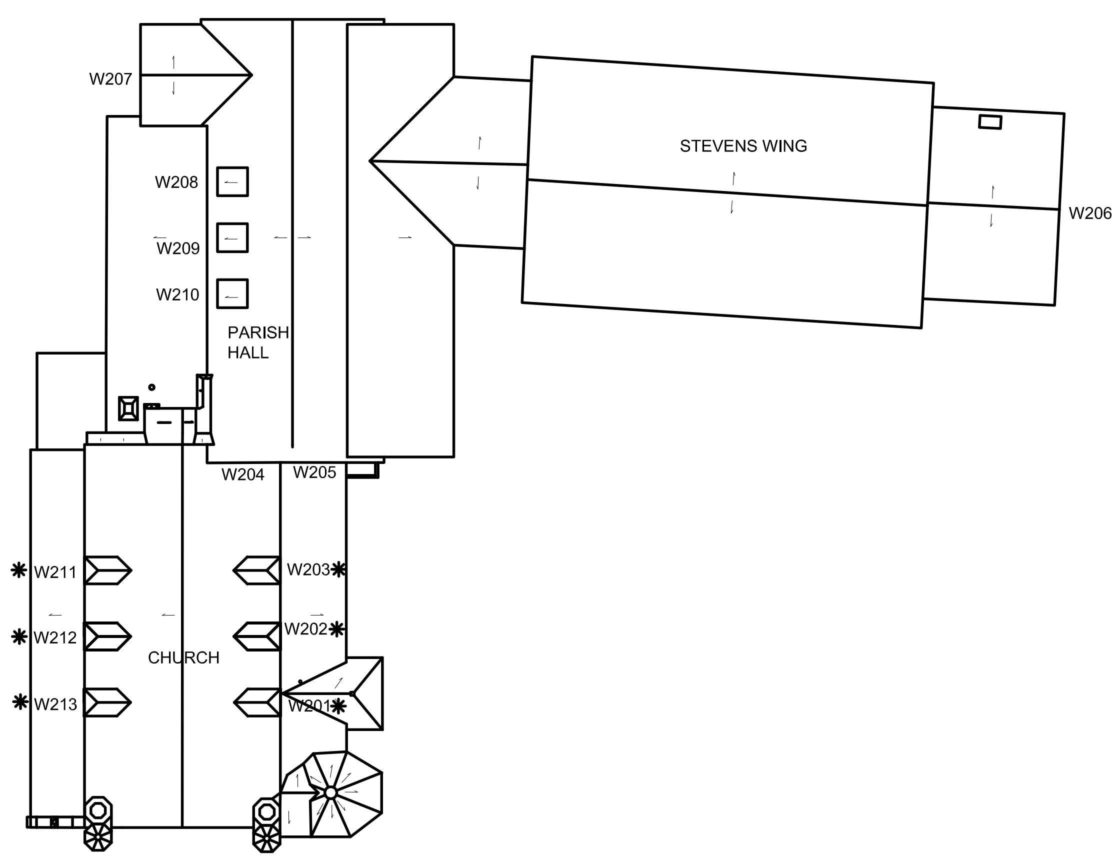
Transom: A window above a door or entryway.

Ventilator: An operating sash set within a stained glass window that allows air movement into the church or building. The ventilator may be single or double-glazed.

Waterproofing: Process whereby **putty** is inserted into the space between the pieces of glass and the leaves of the lead cames. The process may be done “wet” (the putty is thinned with an approved thinner) with brushes or “dry” (use in the consistency from the can) by thumbing it under the leads. The process is best accomplished on the workbench. However, in situ waterproofing can be a useful maintenance procedure.







✳ STAINED GLASS OR LEADED GLASS EVALUATED BY FEMENELLA & ASSOCIATES.

Revisions & Submissions Date

Appendix E

Preservation Plan
First Unitarian Society of Plainfield
724 Park Avenue
Plainfield, New Jersey 07060

Window Key Plan

ANNABELLE RADCLIFFE-TRENNER R.A. NJ# AI 13776
MICHAEL CALAFATI R.A. NJ# AI 09029

Historic Building Architects, LLC
312 West State St. Trenton, NJ 08618 TEL 609 393 3999 FAX 609 393 4333
Certificate of Authorization # AC 245 Expires 01/31/2008

Scale: NTS

Drawn by: CB/AJ

Date: 02/24/08